# 6. Plots in Quarto

Optimally integrating and formatting graphics

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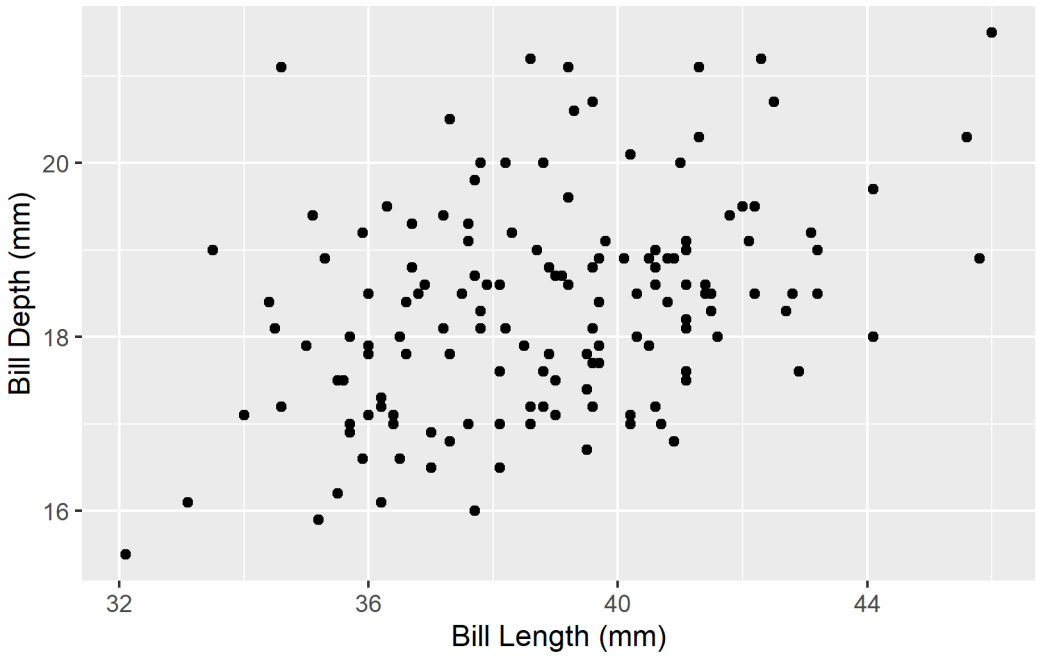
ggplot2 graphics are automatically embedded in Word documents by Quarto. But without further settings, they are often too small, have the wrong resolution, or unreadable labels. In this chapter, you will learn how to optimally configure plots for Word documents.

## A simple plot

Let us start with a scatterplot of bill measurements:

```
ggplot(adelie, aes(x = bill_length_mm, y = bill_depth_mm)) +
  geom_point() +
  labs(
    x = "Bill Length (mm)",
    y = "Bill Depth (mm)"
  )
```



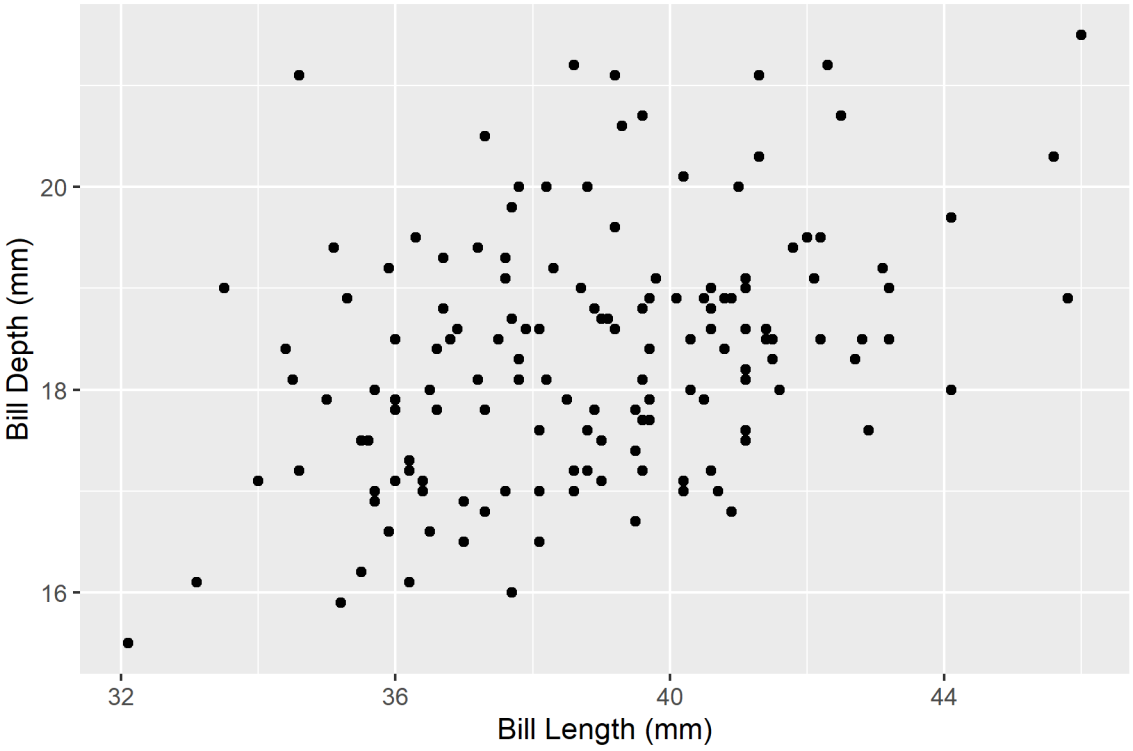

The plot appears, but the size and proportions may not be ideal for the document.

## Controlling size

### fig-width and fig-height

The most important chunk options for plot sizes are `fig-width` and `fig-height` (in inches):

```
ggplot(adelie, aes(x = bill_length_mm, y = bill_depth_mm)) +
  geom_point() +
  labs(
    x = "Bill Length (mm)",
    y = "Bill Depth (mm)"
  )
```




> Tip
>
> Typical sizes for Word documents:
>
> - Full width: `fig-width: 6.5` (corresponds to text width with standard margins)
> - Half width: `fig-width: 3.25`
> - Square: `fig-width: 4, fig-height: 4`

## Aspect ratio

For certain plot types, certain aspect ratios are better suited:

| Plot type | Recommended ratio |
|---|---|
| Scatterplot | 4:3 or 16:9 |
| Bar chart (horizontal) | wider than tall |
| Bar chart (vertical) | taller than wide |
| Time series | 16:9 or 2:1 |

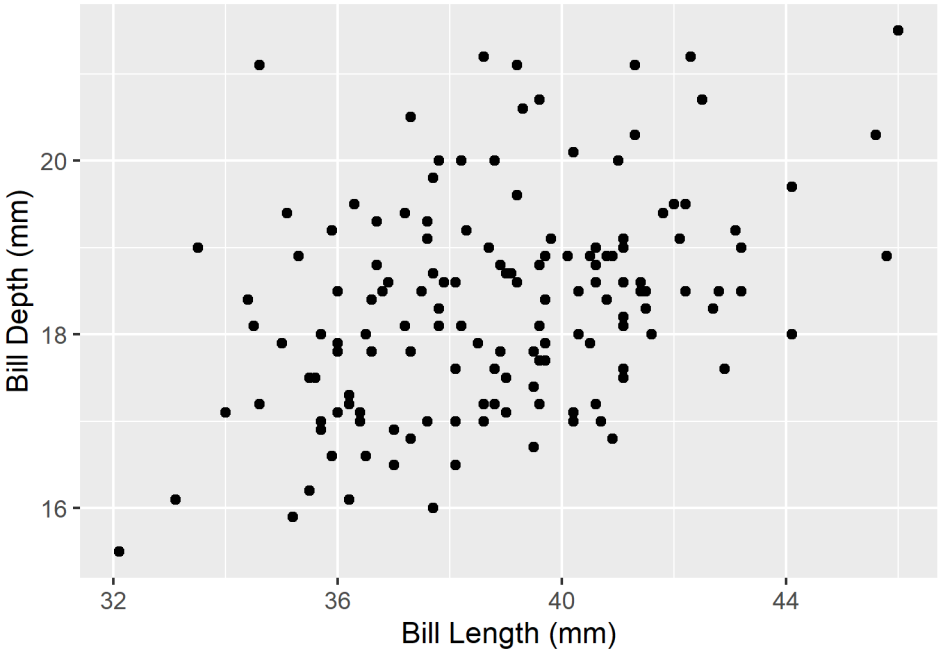
# Resolution

## fig-dpi

Resolution is controlled with `fig-dpi` (dots per inch):

```
ggplot(adelie, aes(x = bill_length_mm, y = bill_depth_mm)) +
  geom_point() +
  labs(
    x = "Bill Length (mm)",
```

```
    y = "Bill Depth (mm)"
  )
```




Recommendations:

- **96 dpi**: Screen/web (fast rendering)
- **150 dpi**: Drafts
- **300 dpi**: Print quality (standard for publications)
- **600 dpi**: High-quality prints

> **i** Note
>
> Higher DPI means larger files and longer render times. For drafts, you can work with lower resolution and only increase to 300 dpi for the final version.

# Figure captions

## fig-cap

A figure caption is added with `fig-cap`:

```
ggplot(adelie, aes(x = bill_length_mm, y = bill_depth_mm)) +
  geom_point(alpha = 0.6) +
  labs(
    x = "Bill Length (mm)",
    y = "Bill Depth (mm)"
  ) +
  theme_minimal()
```

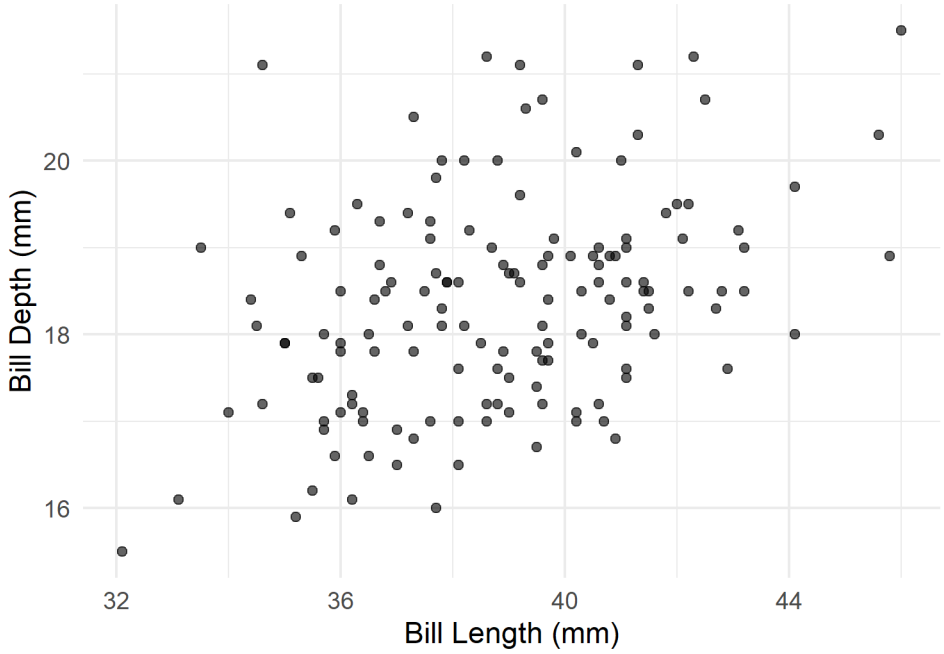



Figure 1: Relationship between bill length and bill depth in Adelie penguins.

> ! Important
>
> For cross-references (Chapter 7), the label must start with `fig-`!

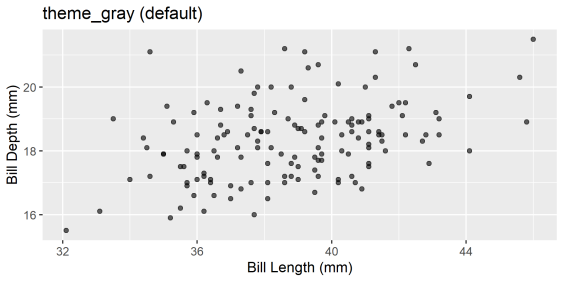
# Themes for publication-ready plots

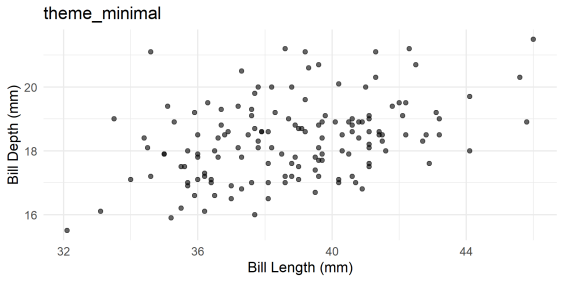
## Standard themes

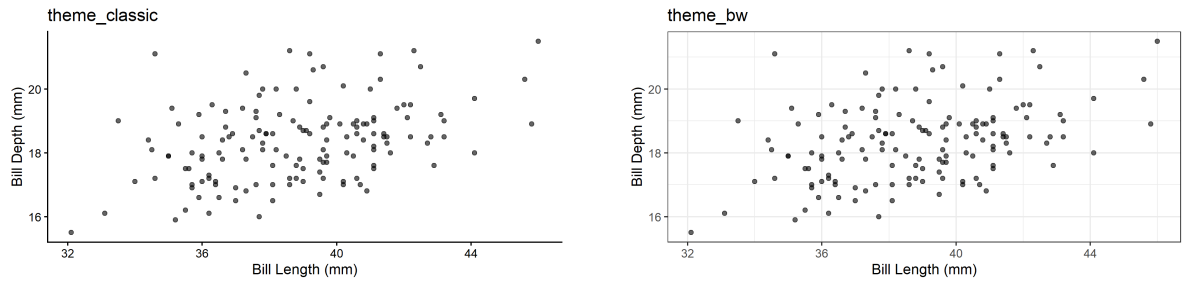
ggplot2 offers several built-in themes:

```
p <- ggplot(adelie, aes(x = bill_length_mm, y = bill_depth_mm)) +
  geom_point(alpha = 0.6) +
  labs(x = "Bill Length (mm)", y = "Bill Depth (mm)")

p + theme_gray() + ggtitle("theme_gray (default)")
p + theme_minimal() + ggtitle("theme_minimal")
p + theme_classic() + ggtitle("theme_classic")
p + theme_bw() + ggtitle("theme_bw")
```



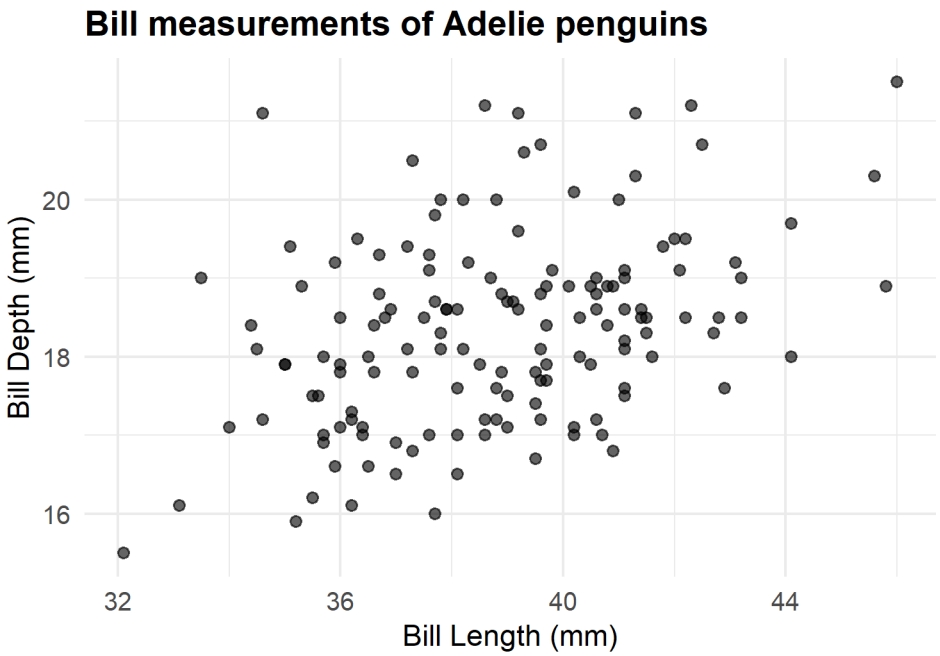



For scientific publications, `theme_minimal()`, `theme_classic()`, or `theme_bw()` are most common.

## Adjusting font sizes

A common problem: Labels are too small in the rendered document. This can be fixed with `theme()`:

```
ggplot(adelie, aes(x = bill_length_mm, y = bill_depth_mm)) +
  geom_point(alpha = 0.6) +
  labs(
    x = "Bill Length (mm)",
    y = "Bill Depth (mm)",
    title = "Bill measurements of Adelie penguins"
  ) +
  theme_minimal(base_size = 12) +
  theme(
    axis.title = element_text(size = 11),
    plot.title = element_text(size = 13, face = "bold")
  )
```

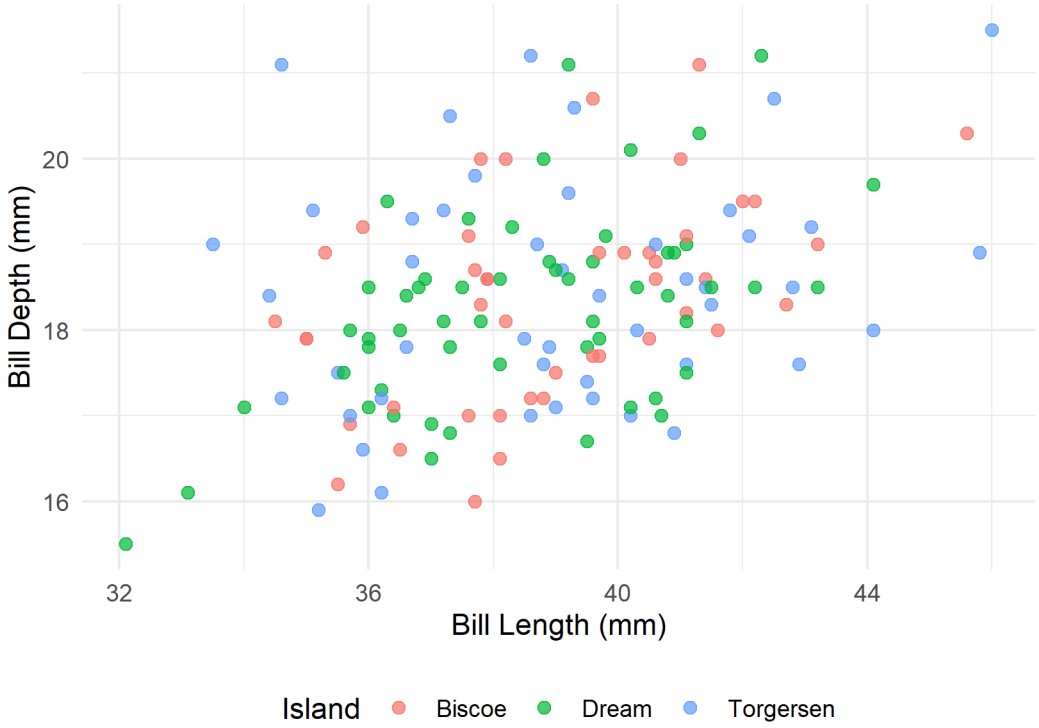



> **Tip**
>
> `base_size` in `theme_minimal(base_size = 12)` scales all text elements proportionally. This is often easier than adjusting each element individually.

# Colors

## Coloring by groups

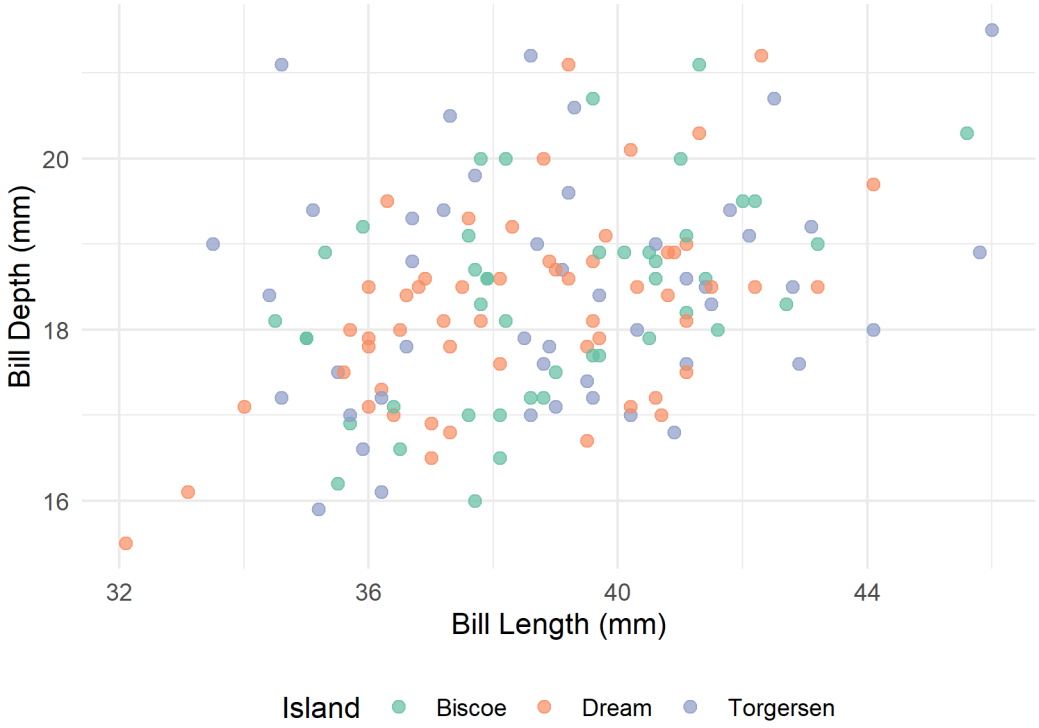
```
ggplot(adelie, aes(x = bill_length_mm, y = bill_depth_mm, color = island)) +
  geom_point(alpha = 0.7, size = 2) +
  labs(
    x = "Bill Length (mm)",
    y = "Bill Depth (mm)",
    color = "Island"
  ) +
  theme_minimal(base_size = 11) +
  theme(legend.position = "bottom")
```




## Color palettes

For scientific publications, I recommend colorblind-friendly palettes:

```
ggplot(adelie, aes(x = bill_length_mm, y = bill_depth_mm, color = island)) +
  geom_point(alpha = 0.7, size = 2) +
  scale_color_brewer(palette = "Set2") +
  labs(
    x = "Bill Length (mm)",
    y = "Bill Depth (mm)",
    color = "Island"
  ) +
  theme_minimal(base_size = 11) +
  theme(legend.position = "bottom")
```




# The plot for our report

Here is a complete, publication-ready plot for our penguin report:

```
ggplot(adelie, aes(x = bill_length_mm, y = bill_depth_mm, color = island)) +
  geom_point(alpha = 0.7, size = 2.5) +
  geom_smooth(method = "lm", se = FALSE, linewidth = 0.8) +
  scale_color_brewer(palette = "Set2") +
  labs(
    x = "Bill Length (mm)",
    y = "Bill Depth (mm)",
    color = "Island"
  ) +
  theme_minimal(base_size = 11) +
  theme(
    legend.position = "bottom",
    panel.grid.minor = element_blank(),
    axis.title = element_text(size = 11),
    legend.title = element_text(size = 10),
    legend.text = element_text(size = 9)
  )
```

```
`geom_smooth()` using formula = 'y ~ x'
```

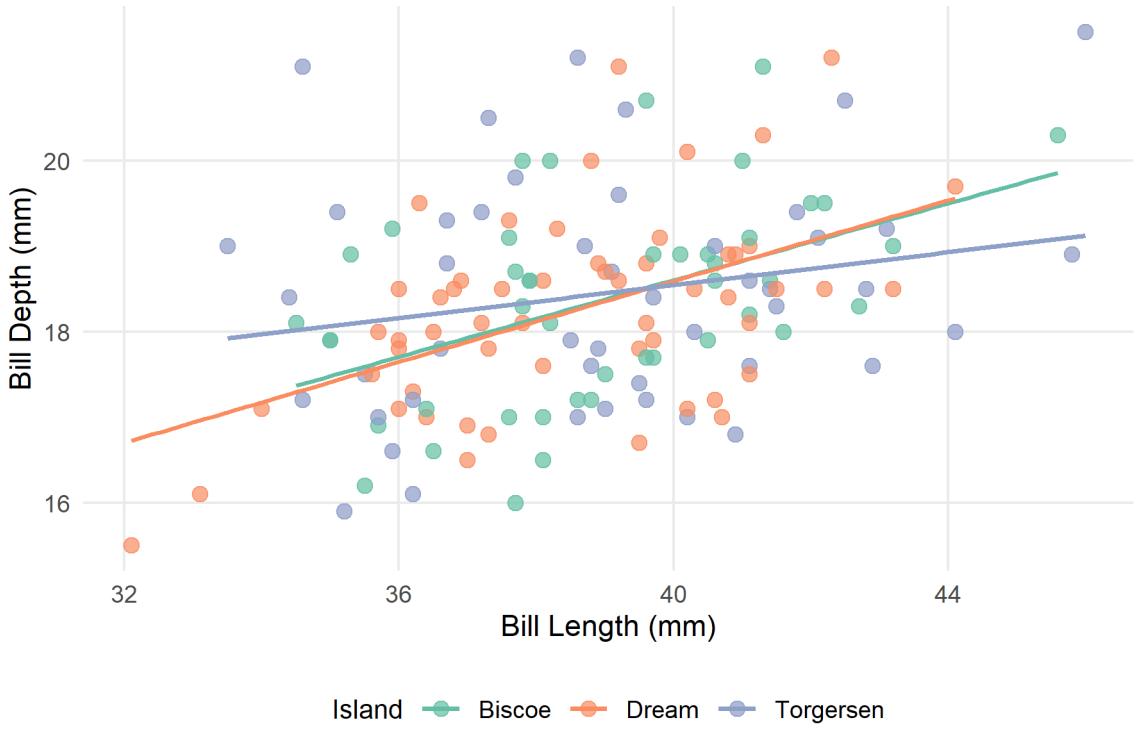



Figure 2: Relationship between bill length and bill depth in Adelie penguins, grouped by island. Each point represents an individual.

# Global plot settings

To avoid repeating the same options in every chunk, you can set global settings in the YAML header:

```
---
title: "My Report"
format: docx
knitr:
  opts_chunk:
    fig-width: 6
    fig-height: 4
    fig-dpi: 300
---
```

Or with `execute:` for Quarto-specific options:

```
execute:
  fig-width: 6
  fig-height: 4
```

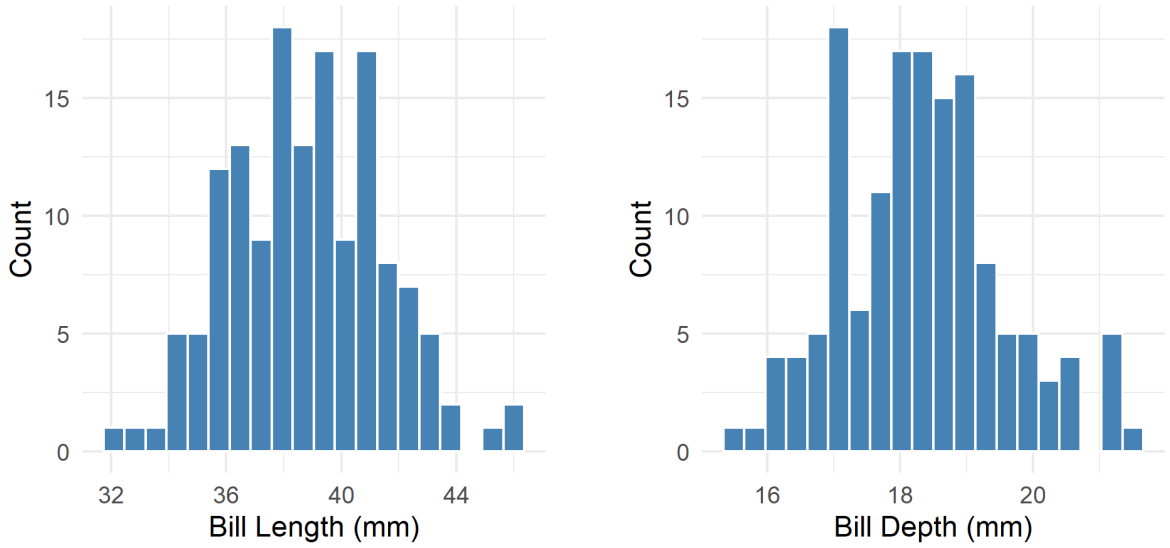
# Multiple plots

## Layout in Quarto

With `layout-ncol`, you can arrange multiple plots side by side:

```
ggplot(adelie, aes(x = bill_length_mm)) +
  geom_histogram(bins = 20, fill = "steelblue", color = "white") +
  labs(x = "Bill Length (mm)", y = "Count") +
  theme_minimal()
ggplot(adelie, aes(x = bill_depth_mm)) +
```

```
  geom_histogram(bins = 20, fill = "steelblue", color = "white") +
  labs(x = "Bill Depth (mm)", y = "Count") +
  theme_minimal()
```




**Exercise: Create a publication-ready plot**

1. Create a boxplot of body mass ( `body_mass_g` ) by island
2. Set appropriate axis labels
3. Use `theme_minimal()` with adjusted `base_size`
4. Add a figure caption with `fig-cap`
5. Experiment with different `fig-width` and `fig-height` values

# Further resources

- Quarto Figures — Official documentation
- ggplot2 book — Comprehensive ggplot2 reference
- R Graphics Cookbook — Practical recipes

# What is next

We can now create tables and plots. In Chapter 7, we will learn how to use cross-references to refer to these elements — “as shown in Figure 1” or “see Table 2”.

# Bibliography